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MUSCULOSKELETAL SYSTEM

PART I

Anatomy, Physiology, and Metabolic Disorders

A compilation of paintings prepared

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Lower Limb

Compartments of Leg

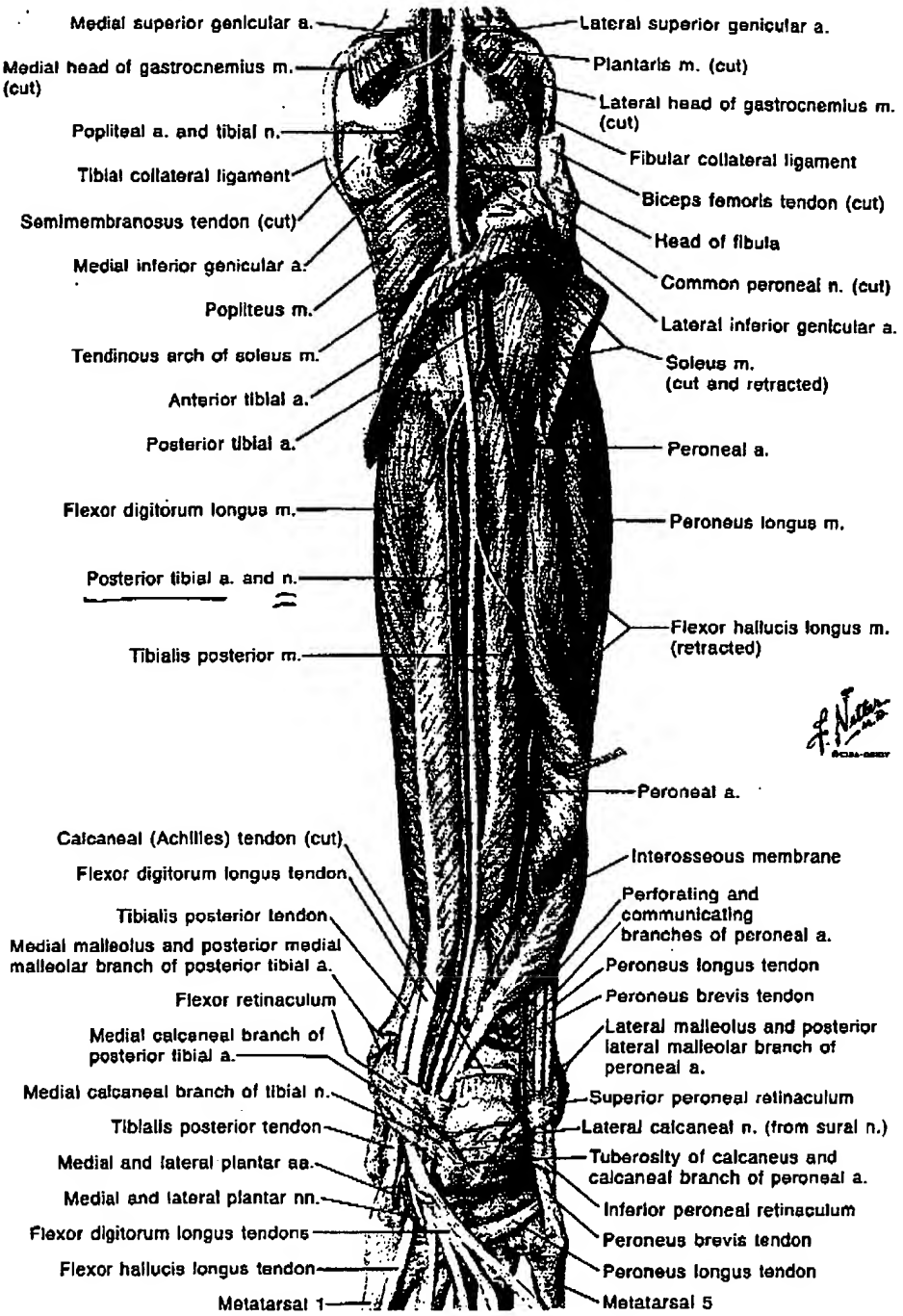
(Continued)

soon as the anterior tibial artery enters the anterior compartment of the leg. It ascends among the fibers of the tibialis anterior muscle and then branches over the front and sides of the knee joint. It anastomoses with the genicular branches of the popliteal artery and with the descending genicular and the lateral circumflex femoral branches of the femoral artery. The *anterior medial malleolar artery* takes origin at the ankle. It passes medialward, deep to the tendons of the tibialis anterior and extensor hallucis longus muscles. It supplies the skin and the ankle joint medially, anastomosing with the malleolar branches of the posterior tibial artery. The *anterior lateral malleolar artery* arises opposite the anterior medial malleolar artery and passes lateralward, deep to the tendons of the extensor digitorum longus muscle. It supplies the lateral surface of the ankle and the joint and anastomoses with the perforating branch of the peroneal artery and with ascending branches of the lateral tarsal branch of the dorsalis pedis artery.

The *posterior tibial artery* begins at the lower border of the popliteus muscle and is the direct continuation of the popliteal artery. Accompanied by its veins and by the tibial nerve, it descends in the deep posterior compartment. At first, it inclines toward the fibula; then, after giving off the peroneal artery, swings medially again and passes behind the medial malleolus at the ankle. It ends deep to the origin of the abductor hallucis muscle by dividing into the medial plantar and lateral plantar arteries. Apart from the plantar artery, which is described separately, and muscular arteries throughout the leg, the branches of the posterior tibial artery are not large. A *nutrient artery* arises in the upper part of the leg to enter the tibia posteriorly. A *communicating branch* passes lateralward, just above the tibiofibular syndesmosis, to join a similar branch of the peroneal artery. The *posterior medial malleolar branch* passes onto the medial malleolus and anastomoses with the anterior medial malleolar branch of the anterior tibial artery, and *medial calcaneal branches* arise just proximal to the artery's division. They reach the skin and areolar tissues of the medial side and back of the heel.

The *peroneal artery* is the largest branch of the posterior tibial artery. It supplies the muscles of the lateral side of the leg and is an important longitudinal collateral vessel through its communicating branch to the posterior tibial artery and its perforating branch to the anterior tibial artery. The peroneal artery arises 2 to 3 cm beyond the origin of the posterior tibial artery and descends near the fibula within the substance of the flexor hallucis longus muscle or between it and the tibialis posterior muscle. A *nutrient branch* enters the nutrient foramen of the fibula. The *perforating branch* passes forward at the distal border of the interosseous membrane to enter the anterior compartment of the leg. It supplies the joints at the ankle and anastomoses with the anterior lateral malleolar branch of the anterior tibial artery and with the lateral tarsal and arcuate branches of the dorsalis pedis artery. The *communicating branch* arises just below the perforating branch, runs medialward deep to the tendon of the flexor hallucis longus muscle, and joins the communicating branch of the posterior tibial artery. The *posterior lateral malleolar branch* supplies twigs to the lateral malleolus and anastomoses with the anterior lateral malleolar branch of the anterior tibial artery. It also gives off *lateral calcaneal branches*.

Muscles, Arteries, and Nerves of Leg: Deep Dissection (posterior view)



Veins. The veins of the leg are paired accompanying vessels of the arteries. They are supplied with numerous valves and receive many perforating communications from the superficial veins. The unions of the venae comitantes of the anterior tibial, posterior tibial, and peroneal veins are made at various levels; they form the popliteal vein. (A single popliteal vein is typically expected at about 5 cm above the knee joint.) The *popliteal vein* is typically a large single vein, ascending through the popliteal space superficial to its artery and between it and the tibial nerve. It is somewhat medial to the artery inferiorly but against its lateral side above the knee joint. Three or four bicuspid valves prevent descending flow in the vein, and one of these valves is rather constantly located just distal to the adductor hiatus. Other tributaries of the popliteal vein are genicular and muscular, as well as the lesser saphenous vein. □

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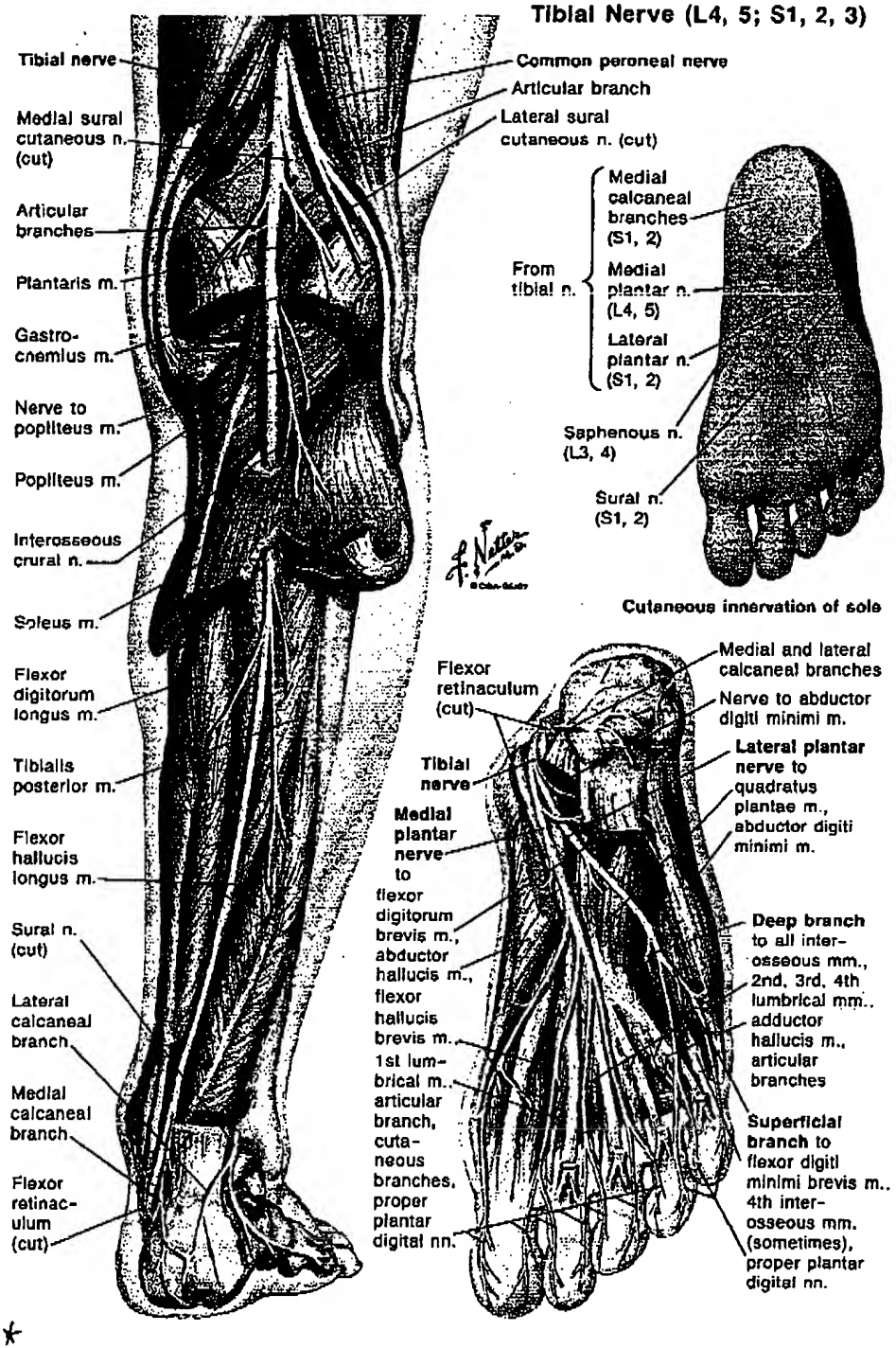
Lower Limb

Nerves of Leg

(Continued)



Tibial Nerve

The *tibial nerve* (L4, 5; S1, 2, 3) is the larger, medial, and terminal branch of the sciatic nerve (Plate 98, see also Plates 73, 77). Its fibers are derived from the anterior divisions of the ventral rami of L4 and L5 and S1, 2, 3.

The tibial nerve continues the line of the sciatic nerve through the popliteal fossa and into the leg. At its origin, the nerve is overlapped by the adjoining margins of the semimembranosus and biceps femoris muscles. In the popliteal fossa, the tibial nerve becomes more superficial, first lying lateral to the popliteal vessels and then crossing obliquely to their medial sides before disappearing into the leg between and beneath the heads of the gastrocnemius and plantaris muscles. Passing over the popliteus muscle and under the tendinous arch of the soleus muscle on the medial side of the posterior tibial vessels, the tibial nerve next enters the space between the gastrocnemius and soleus muscles behind, and the upper part of the tibialis posterior muscle in front. Continuing downward, it crosses over the posterior tibial vessels to reach their lateral sides, so as to lie between the contiguous margins of the flexor digitorum longus and flexor hallucis longus muscles. In the distal third of the leg, the nerve is covered only by skin and fascia as it descends toward the ankle region, where it curves anteroinferiorly into the sole of the foot behind the medial malleolus, deep to the flexor retinaculum and between the tendons of the flexor hallucis longus and the flexor digitorum longus muscles. The nerve ends at this level by dividing into the *medial* and *lateral plantar nerves*.

The tibial nerve consists of muscular, articular, sural, calcaneal, and medial and lateral plantar main branches; it also gives off smaller osseous (medullary) and vascular twigs.

The *muscular branches* supply both heads of the gastrocnemius muscle and the plantaris, popliteus, soleus, tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles. Branches to the gastrocnemius, plantaris, and popliteus muscles and a few that enter the posterior surface of the soleus muscle arise in the popliteal fossa. The branch to the popliteus muscle descends over the posterior surface of the muscle, hooks around its inferior border, and ascends to enter its anterior surface. Branches to the deep surface of the soleus and to the tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles are given off in the upper third of the leg. Vasomotor filaments to the popliteal vessels arise from the main tibial nerve or from its branches in the popliteal fossa.

The *articular branches* help to supply the knee, ankle, and superior and inferior tibiofibular joints and may arise in common with twigs supplying adjacent muscles, bones, and vessels. □

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Lower Limb

Ankle and Foot

Tendon Sheaths at Ankle

The shift from the vertical organization of the leg to the horizontal orientation of the foot entails the turning forward of all tendons, vessels, and nerves that enter the foot. Provision is made by the various retinacula for holding such structures close to the bones at the ankle and for preventing bowstringing by the tendons (Plates 99, 101–103).

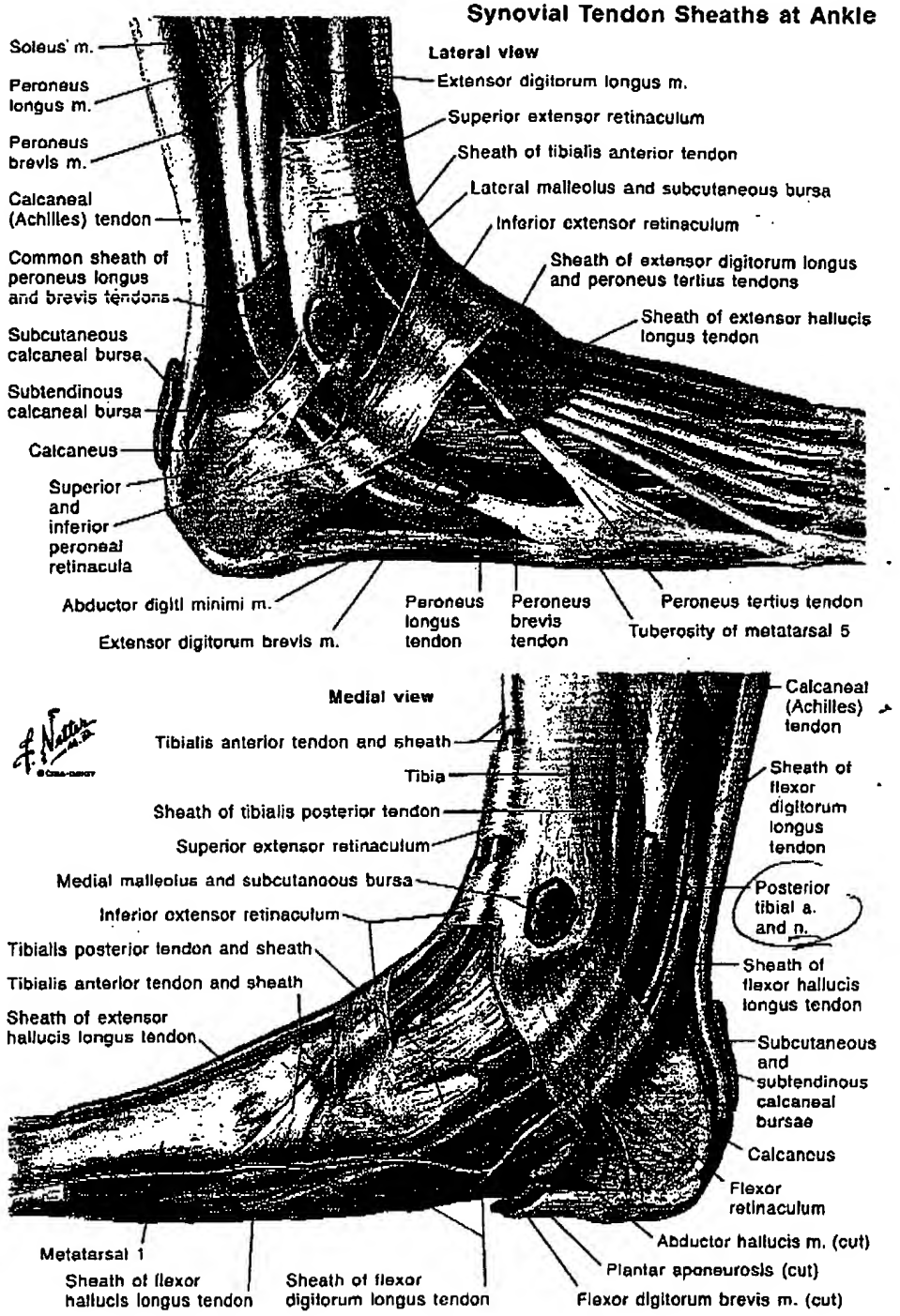
The *superior extensor retinaculum* is a reinforcement of the crural fascia just above the ankle. It is attached laterally to the lower end of the fibula and medially to the tibia, and it covers the structure of the anterior compartment of the leg. A strong septum runs from its deep surface to the tibia, separating a medial compartment for the tendon of the tibialis anterior muscle from a lateral compartment for the tendons of the long extensor muscles.

The *inferior extensor retinaculum* is a well-defined, Y-shaped band overlying the dorsum of the foot and the front of the ankle. The stem of the Y arises from the upper surface of the calcaneus and is in the form of two laminae, one superficial and one deep to the tendons of the peroneus tertius and extensor digitorum longus muscles. At the medial border of the latter tendon, the two laminae merge, and the limbs of the Y begin to diverge. One limb is directed upward and medialward to attach to the medial malleolus. It passes over the tendon of the extensor hallucis longus muscle, the dorsalis pedis vessels, and the deep peroneal nerve, but splits to form a separate canal for the tendon of the tibialis anterior muscle. The lower limb of the Y passes medialward across the medial border of the foot and is lost in the deep fascia of the sole.

The *flexor retinaculum* stretches from the medial malleolus to the medial tubercle of the calcaneus. From its deep surface, septa pass to the back of the lower end of the tibia and the capsule of the ankle joint. The four canals defined by these septa transmit, beginning medially, the tendon of the tibialis posterior muscle, that of the flexor digitorum longus muscle, the posterior tibial vessels and the tibial nerve, and the tendon of the flexor hallucis longus muscle. The upper border of the flexor retinaculum is continuous with the transverse intermuscular septum. Its lower border is continuous with the deep fascia of the sole and gives origin to the fibers of the abductor hallucis muscle.

The peroneal retinacula are thickenings of the fascia on the lateral side of the ankle. The *superior peroneal retinaculum* extends from the lateral malleolus into the fascia of the back of the leg and to the lateral surface of the calcaneus. The *inferior peroneal retinaculum* is a thickening of fascia, both ends of which attach to the lateral surface of the calcaneus. It is continuous superiorly with the stem of the Y of the inferior extensor retinaculum. Deep to the peroneal retinacula pass the tendons of the peroneus longus and peroneus brevis muscles; the peroneus brevis tendon is the anterior of the two behind the medial malleolus and superior to the tendon of the peroneus longus muscle beneath the inferior peroneal retinaculum.

Synovial Tendon Sheaths at Ankle



Ankle Joint

This talocrural articulation is a synovial joint of the hinge (ginglymus) type (Plates 99 and 102). Its form is that of a mortise and tenon, the box-like mortise being formed by the ends of the leg bones. The cartilage-covered articular areas of the end of the tibia, the lateral surface of the medial malleolus, and the triangular facet of the medial surface of the lateral malleolus form the mortise for the trochlea of the body of the talus, which is the tenon. The mortise is deepened behind by the transverse tibiofibular ligament.

The trochlea of the talus is convex from before backward and slightly concave from side to side. Medially, it is straight anteroposteriorly, but its lateral margin is oblique; thus, the trochlea is broader in front than behind. A small articular surface on the anteromedial surface of the trochlea articulates with the medial malleolus. The lateral side of the trochlea is wholly articular; it is triangular in shape and articulates with the lateral malleolus.